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NAVAL POSTGRADUATE SCHOOL
Monterey, California

THESIS

A COMPARATIVE ANALYSIS OF NAVY PERSONNEL RESEARCH PROGRAMS FOR MILITARY SIGNIFICANCE AND INVESTMENT RISK

Robert Dulaney Reeves, II

Thesis
R2784

March 1973

Approved for public release; distribution unlimited.

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A Comparative Analysis of Navy Personnel Research Programs for Military Significance and Investment Risk

by

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Lieutenant Commander, United States Navy
B.A., Williams College, 1961

Submitted in partial fulfillment of the
requirements for the degree of

MASTER OF SCIENCE IN OPERATIONS RESEARCH

from the

NAVAL POSTGRADUATE SCHOOL
March 1973

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ABSTRACT

A recent survey of the Navy Personnel Research Community is subjected to a comparative analysis of the various program elements in the research program in support of General Operational Requirement 43, Personnel Logistics, for military significance and investment risk. The qualitative appraisal of the individuals polled are quantified, using the Ford procedure, and the resultant data analyzed, using a multiple regression model, to determine how much agreement/disagreement there is in the community, where any difference might be, and from which program elements the differences stem. The results should provide assistance for the decision-maker in determining the right project areas for the Navy Personnel Research Program to be maximally effective.

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I. INTRODUCTION

A previous study [Arima, 4] of the Navy's Personnel Research Laboratories noted that the "evaluation of the research and technology end of the R&D spectrum is the difficult problem, that this has to be done subjectively/ qualitatively, and that some sort of panel of experts is an appropriate mechanism."[1] This is because generally applicable, hard measures of the effectiveness of research programs do not exist; thus, the eventual determination is based on the judgmental appraisals of those making the evaluations.

One common "panel of experts" is an advisory board; another, which stems from the work of Pelz and Andrews [6], is the evaluation of effectiveness and quality by peer ratings. This latter method was investigated and reported by Arima and Mister [5]; "the purpose of this study was to develop, validate and test apply a procedure for obtaining qualitative judgments economically and efficiently...and concluded that the Ford procedure could be used to obtain scaled qualitative judgments..with accuracy, efficiency and economy."[2] It suggested that the Ford procedure could be used in analyses with "quality of life" variables for which conventional measurements do not exist, and specifically for analyses "based on the relationship between funding and user ratings, professional estimates of feasibility of finding solutions through research, and the resources actually being programmed for the projects."[3] This initiated a present analysis of the Navy's Personnel Research Program of which this thesis is a part.

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[1] Naval Postgraduate School Report NPS55AA71071A, Evaluation and Innovation in the Navy's Personnel Research Laboratories: I. Preliminary Consideration, James K. Arima, July 1971, p. 30.

The objectives of this analysis were to use the Ford procedure and multiple regression to determine (1) how much agreement/disagreement there is in the Navy personnel research community, (2) where any difference might be, and (3) from which program elements the differences stem. The underlying premise was that the right project areas must be under research in order for the Navy Personnel Research Program to be maximally effective. Determination of the right project areas is beyond the scope of this report, but the information contained herein and other feedback from the Navy Personnel R&D community should provide assistance for the decision-maker in determining the right project ageas.

---

[2] Naval Postgraduate School Report NPS55AA72051A, Evaluation and Innovation in the Navy's Personnel Research Laboratories: II. Development, Validation and Trial Application of a Computer Program to Facilitate Judgmental Appraisal, James K. Arima and Richard W. Mister, May 1972.

[3] Ibid, p. 30.

II. METHOD

A. DATA COLLECTION

The first step in the analysis was to collect the opinions of the Navy RDT&E community on the various program elements in the research program in support of General Operational Requirement (GOR) 43, Personnel Logistics. In order to do this, using the peer rating method as suggested, 263 members of the nine panels listed in Table I which represent a cross-section of the Navy Personnel Research community were chosen as the panels of experts.

TABLE I

Navy Research Personnel Community

Panel	Title
100	Managers, Pers A3 (Personnel Research)
200	Managers, Headquarters Department of Navy
300	Managers, NAVPERSLAB, WASH. D.C.
400	Professionals, NAVPERSLAB, SDGO
500	Professionals, NAVPERSLAB, WASH. D.C.
600	Managers, NAVPERSLAB, SDGO
700	Users (U.S. Naval Officers)
800	Members, NAVPERSLAB Advisory Board
900	Civilian Contractors (Personnel Research)

Questionnaires (see Appendix A) were sent to each member requesting they independently rank the 18 typical research program elements listed in Table II for their military significance, which refers to the needs of the Navy, and investment risk, which refers to the probability of a successful research effort independent of its military significance.

TABLE II

Navy Personnel R&D Program Elements

1. Drug Abuse
2. Education and Training
3. Occupational R&D
4. Manpower/Personnel Cost Systems
5. Manpower Requirements
6. Personnel Management Systems
7. Man-Machine Systems R&D
8. Selection/Classification
9. Applied Systems Development
10. Career Structures
11. Personnel Retention
12. Attitude/Motivation
13. Minority Discrimination Measurement and Reduction
14. Organizational Effectiveness
15. Distribution/Assignment
16. R&D Resource Management
17. Recruitment/Procurement
18. Personnel Performance

B. PROCEDURE TO QUANTIFY THE DATA

These responses were processed using the Ford procedure as adapted for use on the IBM 360/67 computer at the Naval Postgraduate School. This procedure permits each judge to rate only those alternatives which he feels competent to rank, to set his own ranking scheme, and to make use of ties for alternatives deemed equal. The procedure then takes these qualitative ordinal rankings by all the judges within that panel and assigns a quantitative weight to each item in the set being ranked.

It does this by forming a win-loss matrix $A = (a_{ij})$, where a_{ij} represents the number of times program element i was preferred to program element j. If any of the program elements were judged universally high-preferred to all other program elements, or universally low--all other program elements being preferred to it, by any panel that program element would be removed from the matrix and so labeled. A weight, w_i, is then determined iteratively for each of the program elements remaining in the matrix using the equation

$$w_i^{n+1} = \frac{\sum_j a_{ij}}{\sum \frac{a_{ij} + a_{ji}}{w_i^n + w_j^n}}$$

where n is the number of iteration. The weights, w_i^1 and w_j^2, on the first iteration are the win percentage for program element i with respect to program element j for all j, all elements in the matrix. The iterations stop when an assigned convergence/stabilization criteria for all the weights are met or when a specified number of iterations have been completed; in this analysis the convergence criteria was a change of less than 0.005 and the limit on the number of iterations was 50. The set of all these weights is the maximum liklihood of obtaining the original win-loss matrix (less any universal highs or lows). Any individual weight is then the probability or "odds", $\frac{w_i}{w_i + w_j}$, that program element i is preferred to program element j.

C. DESIGN OF THE MODEL

The inputs to any particular personnel research project are professional man years, professional costs, special costs and contract costs; budget allocation was used as a proxy variable for the summation of these costs. Since these costs are not hard (such as weights, size, number, power, et cetera) and the decisions on which personnel research projects to fund and at what level are judgmental, a parametric model was deemed most appropriate in an attempt to analyze the opinions expressed with respect to the Navy Personnel Research Program in support of GOR 43.

The two criteria, military significance and investment risk, of a program element which were ranked by the judges were designated independent variables. The weight assigned by the Ford procedure to a criterion of a program element was used as an observation for that variable by a panel for that program element; this resulted in 18 obervations per panel per variable. Under the assumption that the overall value of a program element was some function of these variables, multiple regression could be used to test the fit of data to various functions and thereby determine which function would produce a consistent model with which to compare data for each panel of judges. The 1973 fiscal year budget allocation for each program element was selected as the dependent variable for these regressions. The rationale for this was the amount of dollars allocated to a program element was a measure of its assumed worth, value or utility to the decision-makers; as such, it seemed reasonable that the amount of money allocated to a program element (C) would also be a function of its military significance (M) and its investment risk (I): $C = f(M,I)$.

Unlike many multiple regression models, this model was not to be used to estimate parameters, the coefficients, nor to predict the dependent variable, budget allocation. This model was developed to compare the data produced by the rankings of the nine panels and thereby indicate the amount of agreement/disagreement among the panels and to indicate the contributors to this difference.

An indirect application of the model was used for comparison of the individual program elements. This was necessitated because there is only one observation for the dependent variable, C, the amount of budget allocation to a program element.

The measure of effectiveness selected for the analysis of these regressions was the coefficient of determination, R^2. This coefficient is defined to be the ratio of the sum of squared deviations about the mean due to the regression to the total sum of squared deviations about the mean,

$$R^2 = \frac{b^T X^T X b}{Y^T Y}$$

, where b is a vector of parameter coefficients, X is a matrix of observations of the independent variables and Y is a vector of observations of the dependent variables. Since "the coefficient of multiple determination may be considered as showing the improvement of the closeness of the regression plane to the actual points relative to the fit of the plane going through the mean"[4], the difference in this coefficient for the regressions with data from the nine individual panels was used as the relative measure of difference between the panels.

If the distribution of the dependent variable, budget allocation of a program element, for the two given independent variables is from a multivariate normal distribution or if this assumption is imposed, more powerful measures of effectiveness are available and stronger statistical tests and conclusions made. The normal assumptions were not used in this analysis because (1) the assumptions seemed to be too restrictive since the analysis was comparative only and (2) with the data base limited to observations from one year, the assumptions could not be readily justified.

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[4] Yamane, Taro, Statistics, An Introductory Analysis, Harper-Row, 1964, p. 652.

III. RESULTS

A. THE DATA QUANTIFIED

Of the 263 questionnaires mailed, 198 responses, 74.5 percent, were returned; Table III presents the responses per panel.

TABLE III

Survey Response

Panel	Questionnaires	Responses	Percent
100	18	16	88.8
200	30	16	53.3
300	18	18	100.0
400	30	28	93.3
500	32	28	87.5
600	30	28	93.3
700	75	44	58.7
800	9	4	44.4
900	21	16	76.2
TOTAL	263	197	74.5

The weights assigned by the Ford procedure for military significance and investment risk are presented in Tables IV and V respectively. Table VI presents the program elements, the rank of their allocated budgets, the mean weight for military significance and its rank, and the mean weight for investment risk and its rank.

TABLE IV

WEIGHTS ASSIGNED MILITARY SIGNIFICANCE

Program Element	Panel 100	Panel 200	Panel 300	Panel 400	Panel 500	Panel 600	Panel 700	Panel 800	Panel 900
1	0.3227	0.1267	0.4342	0.2977	0.2448	0.1728	0.3173	0.2099	0.3514
2	1.2135	0.5606	0.7113	2.7825	0.7789	3.0687	0.7377	1.0021	1.6246
3	0.4134	0.5542	1.0248	0.3121	0.3012	0.3510	0.4132	0.4576	0.2469
4	0.4705	0.7317	0.1684	0.2022	0.3962	0.3060	0.2552	0.2178	0.0552
5	1.0103	1.1297	1.5669	0.2957	0.8706	0.4554	0.6076	0.2123	0.2545
6	0.9275	0.5912	0.3718	0.2943	0.5927	0.4526	0.3570	0.4628	0.2955
7	0.2587	0.2793	0.7535	0.2705	0.5994	0.2998	0.3136	0.1829	0.4940
8	0.3319	0.6941	0.5896	0.9514	0.5166	0.7471	0.5290	0.7922	0.4548
9	0.1456	0.2473	0.9235	0.2648	0.4215	0.3642	0.2780	0.2376	0.4876
10	0.2044	0.2692	0.5292	0.2360	0.3483	0.2641	0.6285	0.5566	0.4982
11	1.3513	0.9712	0.4509	0.9201	1.0004	0.6154	1.6254	1.2404	0.7781
12	0.2444	0.2929	0.2652	0.5931	0.3601	0.2420	0.5499	0.9036	0.7141
13	0.3190	0.1910	0.1105	0.2362	0.1370	0.1731	0.2174	0.2156	0.4730
14	0.2091	0.5201	0.2391	0.3798	0.5379	0.3336	0.4942	0.9856	0.5600
15	0.2926	0.6374	0.2520	0.3216	0.2832	0.5337	0.4278	0.3437	0.5355
16	0.1586	0.1768	0.1677	0.3846	0.3489	0.2602	0.2961	0.3383	0.1935
17	1.9065	0.9210	0.7809	0.8820	0.5679	0.5625	0.5709	0.5914	0.5419
18	0.4339	0.4898	0.3947	0.7894	0.9786	1.3099	0.7824	0.4483	1.0378

TABLE V

WEIGHTS ASSIGNED INVESTMENT RISK

Program Element	Panel 100	Panel 200	Panel 300	Panel 400	Panel 500	Panel 600	Panel 700	Panel 800	Panel 900
1	0.2355	0.0910	0.2247	0.2049	0.2451	0.1331	0.4856	0.1924	0.1983
2	1.7938	0.5780	0.9191	1.8326	0.6806	2.2000	0.8832	0.4608	0.9056
3	0.9565	0.6985	1.1836	0.4809	0.6380	0.4633	0.5270	0.4452	0.3303
4	0.6705	0.5622	0.6969	0.6517	0.8054	0.7511	0.5469	0.7789	0.6964
5	0.6967	0.6736	0.7160	0.6524	0.8601	0.4952	0.5090	0.9703	0.6408
6	1.0102	0.6461	0.3806	0.3975	0.4055	0.4755	0.3631	0.3196	0.4080
7	0.2189	0.5750	0.3819	0.4391	0.7491	0.4938	0.4220	1.5606	0.7790
8	0.6456	0.5796	0.6180	0.5335	0.5535	0.9254	0.6942	0.4791	0.5416
9	1.1416	1.6861	1.9719	0.5996	1.0119	0.7562	0.4386	0.8807	0.7145
10	0.4240	0.4654	0.8144	0.4701	0.2932	0.4482	0.4400	0.4085	0.4906
11	0.2891	0.4320	0.2571	0.3099	0.4549	0.2130	0.5475	0.3785	0.3604
12	0.1587	0.1428	0.1372	0.2431	0.2541	0.1173	0.4403	0.1422	0.2393
13	0.1278	0.1475	0.1156	0.2616	0.1448	0.2138	0.3436	0.0829	0.3880
14	0.0722	0.3328	0.2163	0.2106	0.4267	0.1662	0.3148	0.2768	0.1814
15	0.6910	0.6014	0.6105	0.8512	0.3301	1.0304	0.7057	0.3606	0.3792
16	0.2832	0.2869	0.1347	0.3743	0.2319	0.2567	0.2988	0.3414	0.5965
17	0.4412	0.7800	0.2991	0.6297	0.4938	0.3185	0.4229	0.8563	0.6517
18	0.1673	0.3541	0.3629	0.5013	0.6585	0.6207	0.7251	1.3092	0.6928

TABLE VI

PROGRAM ELEMENTS, BUDGET RANK, MEAN MILITARY SIGNIFICANCE AND RANK, MEAN INVESTMENT RISK AND RANK

PROGRAM ELEMENT	BUDGET RANK	MEAN MIL. SIG. WEIGHT	RANK	MEAN INV. RISK WEIGHT	RANK
1. Drug Abuse	14	0.2753	16	0.2234	16
2. Educ. & Training	1	1.3867	1	1.1393	1
3. Occup. R & D	7	0.4527	10	0.6359	5
4. Man. Cost Sys.	13	0.3115	15	0.6845	4
5. Man. Rgmts.	6	0.7115	5	0.6905	3
6. Pers. Mgmt. Sys.	7	0.4828	7	0.4896	11
7. Man-Mach. Sys.	16	0.3835	13	0.6244	6
8. Sel./Class	11	0.6230	6	0.6190	7
9. Applied Sys.	3	0.3745	14	1.0223	2
10. Career	2	0.3927	12	0.4727	12
11. Retention	12	0.9948	2	0.3536	13
12. Attitude	4	0.4628	9	0.2083	17
13. Minority	17	0.2303	18	0.2028	18
14. Organization	15	0.4733	8	0.2442	15
15. Distribution	10	0.4031	11	0.6178	8
16. R & D Resources	18	0.2583	17	0.3116	14
17. Recruitment	5	0.8139	3	0.5437	10
18. Performance	9	0.7405	4	0.5466	9

Table VII presents a summary of the criterion ranked higher. A majority of the nine panels of experts ranked the investment risk of nine of the program elements higher than the military significance, one program element Applied Systems Development, was ranked highest by all groups. Eight program elements were ranked higher in military significance; three were so ranked without any dissent: Personnel Retention, Attitude/Motivation, Organizational Effectiveness. The nine panels were split in their ranking of one program element, R&D Resource Management, four panels ranked it higher in military significance, four ranked it higher in investment and one ranked it about equal in each.

TABLE VII

CRITERION RANKED HIGHER

Program Elements Ranked Higher in Investment Risk

Occupational R & D
Manpower/Personnel Cost Systems
Personnel Management
Man-Machine Systems R & D
Selection/Classification
Applied Systems Development
Career Structures
Minority
Distribution/Assignment

Program Elements Ranked Higher in Military Significance

Drug Abuse
Education and Training
Personnel Retention
Attitude Motivation
Organizational Effectiveness
Recruitment/Procurement
Personnel Performance
Manpower Requirements

Program Elements Ranked Equal in the Two Criteria

R & D Resource Management

These results seemed to indicate a certain degree of agreement among the panels about the relative position of a program element or the two criteria, in that either investment risk or military significance of all but one element was assigned a higher weight by a majority of the panels of experts. Additionally, the ranks of these weights for the 18 program elements by the nine panels for each of the two criteria indicated some degrees of agreement/disagreement among the panels; Tables VIII and IX present the rank of the assigned weight of a program element by a panel for each of the two criteria.

TABLE VIII

RANK OF PROGRAM ELEMENTS BY THE WEIGHT ASSIGNED MILITARY SIGNIFICANCE

	TITLE	100	200	300	400	500	600	700	800	900	AVG*
1.	Drug Abuse	10	18	10	13	17	18	13	17	13	16
2.	Educ. & Trng.	3	8	6	1	4	1	3	2	1	1
3.	Occup. R & D	8	9	2	10	15	10	11	9	16	10
4.	Man. Cost Sys.	6	4	16	18	11	12	17	14	18	15
5.	Man. Rgmts.	4	1	1	11	3	7	5	16	15	5
6.	Pers. Mgmt. Sys.	5	7	12	12	6	8	12	8	14	7
7.	Man-Mach Sys.	13	13	5	14	5	13	14	18	9	13
8.	Sel./Class	9	5	7	2	9	3	8	5	12	6
9.	Applied Sys.	18	15	3	15	10	9	16	13	10	14
10.	Career	16	14	8	17	14	14	4	7	8	12
11.	Retention	2	2	9	3	1	4	1	1	3	2
12.	Attitude	14	12	13	6	12	16	7	4	4	9
13.	Minority	11	16	18	16	18	17	18	15	11	18
14.	Organization	15	10	15	8	8	11	9	3	5	8
15.	Distribution	12	6	14	9	16	6	10	11	7	11
16.	R & D Resources	17	17	17	7	13	15	15	12	17	17
17.	Recruitment	1	3	4	4	7	5	6	6	6	3
18.	Performance	7	11	11	5	2	2	2	10	2	4

* Rank of the average (mean) weight assigned to a program element.

TABLE IX

RANK OF THE ELEMENTS BY THE WEIGHT ASSIGNED INVESTMENT RISK

	TITLE	100	200	300	400	500	600	700	800	900	AVG*
1.	Drug Abuse	13	18	14	18	16	17	9	16	17	16
2.	Educ. & Trng.	1	8	3	1	5	1	1	8	1	1
3.	Occup. R & D	4	3	2	9	7	10	7	9	15	5
4.	Man, Cost Sys.	7	10	6	4	3	5	6	6	4	4
5.	Man. Rgmts.	5	4	5	3	2	7	8	3	7	3
6.	Pers. Mgmt. Sys.	3	5	10	12	12	9	15	14	11	11
7.	Man-Mach. Sys.	14	9	9	11	4	8	14	1	2	6
8.	Sel./Class	8	7	7	7	8	3	4	7	9	7
9.	Applied Sys.	2	1	1	6	1	4	12	4	3	2
10.	Career	10	11	4	10	14	11	11	10	10	12
11.	Retention	11	12	13	14	10	15	5	11	14	13
12.	Attitude	16	17	16	16	15	18	10	17	16	17
13.	Minority	17	16	18	15	18	14	16	18	12	18
14.	Organization	18	14	15	17	11	16	17	15	18	15
15.	Distribution	6	6	8	2	13	2	3	12	13	8
16.	R & D Resources	12	15	17	13	17	13	18	13	8	14
17.	Recruitment	9	2	12	5	9	12	13	5	6	10
18.	Performance	15	13	11	8	6	6	2	2	5	9

* Rank of the average (mean) weight assigned to a program element.

B. MODEL SELECTION

The weights assigned to military significance, M, and investment risk, I, by each of the panels were ordered by their rank and the weights plotted, as were the budget allocations for program elements, C. Since program element numbers 1-18 were randomly assigned initially the order of the data had no effect; plotting the data suggested various functions to test for their fit. Several linear and log-linear functions were investigated with the data in a search for the most consistent model for C = f(M,I). These are listed in Table X, each was tested with and without the constant, b_o.

TABLE X

Parametric Models Tested

$C = b_o + b_1 M + b_2 I + e$

$C = b_o + b_1 M + b_2 I + b_2 M*I + e$

$C = b_o + b_1 M + b_2 I + b_3 M/I + e$

$C = b_o + b_1 M + b_2 I + b_3 I/M + e$

$C = b_o + M^{b1} I^{b2} + e$

$C = b_o M^{b1} I^{b2} M*I^{b3} + e$

$C = b_o M^{b1} I^{b2} M/I^{b3} + e$

$C = b_o M^{b1} I^{b2} I/M^{b3} + e$

Note: In these models, $C = (C_i)$, where C_i is the budget allocation for program element i; $M = (M_i)$, where M is the weight assigned the military significance of program element i, I = (I_i), where I_i is the weight assigned the investment risk of program element i; i = 1, 2, ..., 17, 18.

The investigation indicated that the simplest two-variable model, $C = b_o + b_1M + b_2I$, gave the most consistent results and the best fit for the data. This model was developed assuming that the partial derivatives of the function with respect to each of the variables M and I to be positive and to reflect that (a) the greater the military significance the more money will be allocated to that program element and (b) the better the investment risk, the more likely money will be allocated to that program element. Using linear equations to express this mathematically, the differential equations:

1) $\delta \frac{f}{m} = b_1 \quad , \quad b_1 > o$

2) $\delta \frac{f}{I} = b_2 \quad , \quad b_2 > o$

yield the above equation as the solution to $C = f(M,I)$.

C. COMPARISONS OF PANELS

This model was then used with the FY '73 allocation and the weights assigned to M and I by the Ford procedure for each of the nine panels. The step-wise regressions were computed using BIMED02R as programmed at NPS; Table XI presents the final results for each of the nine panels. There were no indications of multicollinearity or hetereoscedasticity in any of the regressions. The difference in the coefficients of determination, R^2, is a relative measure of the difference between the panels over the budget allocated to Navy Personnel Research programs in support of GOR 43.

TABLE XI

Regression Results for All Program Elements

Panel	R^2	F
100	.6206	12.267
200	.0403	0.315
300	.1210	1.032
400	.8896	60.422
500	.1065	0.894
600	.8369	38.486
700	.4094	11.089
800	.1774	1.617
900	.6591	14.499

These results seemed to indicate a reasonably good fit for five of the panels (100, 400, 600, 700, 900)[5], but not for the remaining four. Under the assumption that this represented a possible demarcation line of agreement and disagreement within the community, the equality[6] of all possible pairs of regressions were tested to determine if the two regressions came from the same population, under the null hypotheses $\beta_1 = \beta_2$, versus the alternative hypothesis, $\beta_1 \neq \beta_2$. At $\alpha = 0.05$, none of the null hypotheses could be rejected; thus, it was concluded that all of the panels came from the same population.

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[5] If the normality assumptions are imposed, these five F-statistics are significant for the null hypothesis Ho: $\beta = 0.0$, with $\alpha = 0.10$.

[6] Thiel, Henri, Principles of Econometrics, Wiley, 1971, p. 147.

An aggregated coefficient of determination was derived by regressing 162 observations (9 panels x 18 observations per panel) for a consolidated panel, all in the model. This coefficient can be compared to that for an individual panel. Additionally, nine regressions with data from eight of the panels were computed. This changed the aggregated coefficient of determination, reflecting the contribution of the excluded panel's observations, thus providing another means of comparison.[7] These results are presented in Table XII. As expected, excluding a panel which had a reasonably good fit decreased R^2, whereas excluding a panel which did not fit the model will increase this coefficient.

TABLE XII

Regression Results Excluding One Panel

Panel	R^2	F
all	.3362	40.235
100*	.3237	33.747
200*	.3796	43.128
300*	.3729	42.279
400*	.2719	26.322
500*	.3657	40.643
600*	.2747	26.696
700*	.3575	39.222
800*	.3711	41.596
900*	.3194	33.083

* panel excluded

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[7] The rationale for this will be discussed in Section IV.

Since there was a certain relationship between some of the panels, such as between the Managers and Professionals at NAVPERSLAB, SDGO, and possible relationships among others, data from these pairs of panels were regressed in the model. These results are presented in Table XIII; Table XIV presents the results of regressions of the data from the other seven panels.

TABLE XIII

Regression Results for Panel Pairs

Panels	R^2	F
All	.3362	40.235
100 & 200	.2792	6.392
300 & 500	.1032	1.899
400 & 600	.8460	90.633
300 & 600	.4505	13.527
400 & 500	.4841	15.483

TABLE XIV

Regression Results Excluding Panel Pairs

Panels	R^2	F
All	.3362	40.235
100 & 200	.3708	36.362
300 & 500	.4149	43.604
400 & 600	.1923	14.642
300 & 600	.3123	27.931
400 & 500	.2963	25.890

D. COMPARISONS OF NAVPERSLABS

Since the majority of this research is done in the two Naval Personnel Research and Development Laboratories, one in San Diego and the other in Washington, D.C., the program elements conducted primarily under their auspices[8] were regressed in the model. Table XV presents these results for the consolidated panel and each of the individual panels for the Washington laboratory program elements; Table XVI, the results for the San Diego laboratory.

TABLE XV

Regression Results from Program Elements
Under Cognizance of NAVPERSLAB, WASH, D.C.

Panel	R^2	F
All	.1308	7.224
100	.3030	1.739
200	.1840	0.904
300	.3238	1.915
400	.2209	1.137
500	.0361	0.150
600	.2041	1.026
700	.5154	4.254
800	.0505	0.021
900	.2617	1.418

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[8] Reference 1. Program elements 1, 3, 4, 51 7, 9, 10, 12, 14, 16 and 17 are to NAVPERSLAB, WASH, D.C.; the other to NAVPERSLAB, SDGO.

TABLE XVI

Regression Results from Program Elements Under Cognizance of NAVPERSLAB, SDGO.

Panel	R^2	F
All	.4827	19.907
100	.7864	7.363
200	.0371	0.077
300	.6626	3.948
400	.9614	50.404
500	.4239	1.471
600	.9348	28.661
700	.4250	1.478
800	.2064	1.300
900	.6578	3.845

E. COMPARISONS OF FUNCTIONAL AREAS

The program elements in the Naval R&D Program are separated into the six functional areas[9] listed below. The numbers in parentheses coincide with the numbers assigned program elements in that area.

Manpower Resources Management (3, 4, 5, 10)
Personnel Operations R&D (6, 8, 11, 13, 15, 17, 18)
Organizational Management (1, 12, 14)
Human Factor Engineering (7, 9)
Education and Training (2)
R&D Resource Management (16)

Regression results from the first two areas are presented in Tables XVII and XVIII respectively. Results for the other areas are not directly available from this model presently.[10] Caution must be used when referring to these tables since the number of observations are small.

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[9] Bureau of Naval Personnel R&D Program FY '73.

[10] This will be discussed in Section IV.

TABLE XVII

Regression Results from Program Elements in the Manpower Resources Management Functional Area

Panel	R^2	F
All	.2345	5.054
100	.2085	0.132
200	.7114	1.233
300	.1228	0.070
400	.4804	0.462
500	.9019	4.594
600	.9106	5.091
700	.9244	6.112
800	.9987	380.440
900	.9903	50.891

TABLE XVIII

Regression Results from Program Elements in the Personnel Operations R&D Functional Area

Panel	R^2	F
All	.2964	12.640
100	.5544	2.488
200	.7219	5.193
300	.6764	4.180
400	.4824	1.864
500	.4944	4.889
600	.2104	0.533
700	.0827	0.180
800	.3695	1.172
900	.0876	0.192

F. COMPARISONS OF PROGRAM ELEMENTS

The model selected did not provide direct comparisons for the individual program elements since the data consists of FY '73 observations only.[11] An indirect method utilizing the model was attempted; this approach is the same as that in Section III E when one panel's observations of all 18 program elements were excluded from the composite panel of all nine panels. This method was suggested by the Jackknife procedure for bias reduction [3] and its resultant pseudo-values. Each panel was regressed using 17 program elements, excluding a different element each time. A pseudo-coefficient of determination, P, for the regression without one of the program elements was thus provided.

The difference between the coefficient of determination and the pseudo-coefficient indicated whether the excluded element had a positive or negative contribution to the overall regression. A positive contribution occurred when an excluded element produced a lower pseudo-coefficient of determination, and a negative contribution occurred when the pseudo-coefficient was higher. Mathematically the positive contribution occurs because the excluded element produces a greater contribution to the computed sum of squares than it does to the actual sum of squares; whereas a negative contribution produces a lesser contribution to the computed sum of squares than it does to the actual sum of squares.

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[11] This will be discussed in Section IV.

The percentage amount of this contribution, $(P - R^2)/R^2$, indicated the difference between the panels for the program element excluded. R^2, P and this percentage are presented in Table XIX for the 18 program elements.

TABLE XIX

R^2, P, %R

Panel		100	200	300	400	500	600	700	800	900
	R^2	.6206	.0403	.1210	.8896	.1065	.8396	.4094	.1774	.6591
PE*										
1	P	.6140	.0262	.1109	.8891	.0920	.8347	.4116	.1625	.6556
	%	1.2	-35.0	- 8.3	- 0.1	-13.6	- 0.3	- 0.5	- 8.4	- 0.5
2	P	.3158	.2950	.3176	.2056	.0871	.0979	.1198	.0690	.0647
	%	-49.1	632.0	79.7	-76.9	-18.2	-88.3	-70.7	-61.1	-90.2
3	P	.6486	.0414	.1443	.8928	.1065	.8400	.4106	.1774	.6928
	%	4.5	2.0	19.2	0.4	0.0	0.4	0.3	0.0	5.1
4	P	.6360	.0457	.1241	.8935	.1122	.8387	.4244	.1690	.6636
	%	2.5	13.4	2.6	0.4	5.4	0.2	3.7	3.0	0.7
5	P	.6312	.0468	.1392	.8897	.1274	.8382	.4094	.1831	.6687
	%	1.7	16.1	15.0	0.0	19.6	0.2	0.0	3.2	1.5
6	P	.6775	.0412	.1212	.8975	.1067	.8377	.4271	.1776	.6767
	%	9.2	2.2	0.2	0.9	0.2	0.1	4.3	0.1	2.7
7	P	.6105	.0378	.1205	.8912	.1314	.8392	.3997	.1767	.7066
	%	- 1.6	- 6.2	- 0.4	0.2	23.4	0.3	- 2.4	- 1.3	7.2
8	P	.6234	.0425	.1225	.9044	.1073	.8556	.4690	.1935	.6586
	%	0.5	5.5	1.2	0.5	0.8	2.2	3.9	9.1	- 0.1
9	P	.6499	.0652	.2295	.8966	.1049	.8426	.4215	.1904	.6585
	%	4.7	61.8	88.0	0.8	- 1.5	0.7	3.0	14.7	- 0.1
10	P	.6425	.0453	.1179	.9143	.1204	.8627	.4244	.1781	.6654
	%	3.5	12.4	- 2.6	2.7	13.4	3.1	3.7	0.4	1.0
11	P	.6199	.0449	.1184	.8918	.1424	.8368	.4654	.2916	.6768
	%	- 0.1	11.4	- 2.1	0.2	34.7	0.0	13.7	64.4	2.7
12	P	.6689	.0483	.1327	.9067	.1151	.8676	.4176	.1830	.6592
	%	7.8	19.9	9.7	0.8	8.3	2.5	2.0	3.2	0.0
13	P	.6106	.0239	.1019	.8865	.0811	.8326	.3926	.1551	.6600
	%	- 1.6	-40.7	-15.8	- 0.3	-24.5	- 0.5	- 4.1	-12.6	0.1
14	P	.6220	.0345	.1088	.8877	.1077	.8344	.4016	.2495	.6560
	%	0.2	-12.4	-10.1	- 0.2	1.2	- 0.3	- 1.9	40.6	- 0.5

TABLE XIX (Cont'd)

Panel		100	200	300	400	500	600	700	800	900
15	P	.6250	.0421	.1207	.9023	.1061	.8469	.4759	.1771	.6585
	%	0.7	4.5	- 2.2	0.3	- 0.4	1.2	-16.2	- 0.7	- 0.1
16	P	.6089	.0257	.1006	.8940	.1918	.8353	.3897	.1610	.6492
	%	- 1.9	-36.2	-16.9	- 0.5	-82.4	- 0.2	- 4.8	- 9.3	- 1.4
17	P	.6289	.0429	.1226	.8964	.1063	.8392	.4185	.1783	.6603
	%	1.3	6.5	1.3	0.8	- 0.2	0.3	2.2	0.5	0.2
18	P	.6380	.0392	.1198	.8941	.1392	.9048	.4860	.1812	.7914
	%	2.8	- 2.7	- 1.0	0.5	31.6	8.1	18.7	2.1	4.9

* PE* = Number of Program Element Excluded

IV. DISCUSSION

The overall response, 74.5 percent, was considered sufficient to provide an adequate data base for the analysis. The response per panel, as shown previously in Table III, seemed ample as to be representative, with the possible exception of Panels 200, 700 and 800. The sensitivity of the Ford procedure to an individual judge is the ratio of the number of pairwise comparisons he makes to the total number of comparisons made by his panel, thus, the more program elements ranked, the more ranks used and the fewer ties allowed, the more the influence of that judge.

In all the panels, except 200, 700 and 800, the number of total comparisons was such that the most influential judge contributed about eight percent as compared to an expected mean contribution of 6.25 percent; whereas the least influential contributed four percent. The representability of the Ford results were further verified when, prior to the final computations, the sizes of three of the panels were increased and the resulting change in the assigned weights were small.

The weights assigned by panels 200, 700 and 800 however, are subject to significant change with an inclusion of additional responses. Accordingly, these panels were included in the analysis for completeness, but were not accepted as representative.

Three criteria were used in the evaluation of the consistency of each of the multiple regression models tested. These were whether (1) the signs of the parameter coefficients, b_1 and b_2 were similar for each set of data, (2) these coefficients were intuitively reasonable with their mathematical derivation, and (3) each step in the regression produced only modest and logical changes.

The model thus selected is comparative only; it does not mean that this function completely describes, nor best fits the determination of the Navy Personnel Research Program in support of GOR 43, and this was not its purpose. Additionally, it does not mean that the panels whose data fit the model "best" are those whose judgments are "best" or correct.

Tables XI and XII show that indeed the model did provide results which indicated a substantial difference between panels of the personnel research community in their rankings of program elements. This was reflected primarily by the difference in the coefficients of determination but also by the difference in the parameter coefficients as well as in the mean and standard deviations of weights assigned military significance and investment risk. There was a distinct split of the community into two groups; those whose data fit the model reasonably well and those whose did not fit the model well. The results also reflected a difference of the two panels of the Department of the Navy located in Washington, D.C., a difference in the two NAVPERSLABS--both from the managers' rankings and the professionals' rankings, and yet a similarity in the rankings of the professionals and managers for the same NAVPERSLAB. The results in Tables XII and XIV substantiated this finding.

The results from the model when it was applied to work at each of the two NAVPERSLABs, Table XV and XVI, indicated significant differences between the work at the laboratories, and relatively more agreement between panels. In general, the model results indicated a reasonable fit for the program elements at San Diego, but not at Washington, D.C.

It seems noteworthy to mention that data from the two panels at NAVPERSLAB, WASHDC provided distinctly different results for work at their laboratory, and that both their rankings of program elements at NAVPERSLAB, SDGO provided a substantially better fit to the model. The data from both panels at the San Diego laboratory provided results consistent with the rest of the community for program elements at Washington; whereas the results for their own work were higher than the rest of the community.

The results from the model when it was used with data from the functional areas distinguished differences between the panels. These indicated areas/program elements from whence these differences stemmed.

In the Manpower Management area, all the program elements are work from NAVPERSLAB, WASHDC, as are the program elements in the area of Organizational Management. Comparing the results for each panel from Table XVII indicate a generally better fit in the Manpower area; the exceptions are panels 100 and 300. Furthermore, the results for the two panels from the Washington laboratory are significantly different in this area. This assists in the explanation for their overall difference previously mentioned.

The program elements in the Personnel Operations area are assigned to NAVPERSLAB, SDGO; their only other element is number two, Education and Training. Comparing the results in Tables XII and XIV, there is a better fit in the Personnel Operations area for panels 200 and 800, and a slightly better fit for panels 300 and 500. There is a significant difference in the fit for the two San Diego panels within this area, as well as between the two areas. This indicated that Program Element Two contributed substantially to the fit for all program elements at their laboratory, as well as that there is some disagreement between the two panels in the Personnel Operations area.

The results from the model for comparison of the individual program elements were not strong since the data base consisted of observations for only one year. Previous years budget data were available but judgments from earlier years for the independent variables, M and I, were not. Thus, although there are nine observations, one for each panel, for M and I, there is only one observation for C; hence C, the amount of budget allocation to a program elements, does not vary linearly with changes in military significance and investment risk as hypothesized by the model. Accordingly, application of the model with this data results in a regression which states that C equals the constant, b_0, and that b_1 and b_2 are zero. Future repetition of the survey would provide the additional data necessary for application of the model directly with individual program elements.

The indirect application of the model provided a method which allowed comparisons of an individual program element between the panels and between program elements within a panel. These results coincided with results from direct application of the model. For example, as previously mentioned, the two NAVPERSLAB, WASHDC panels differed distinctly over work on program elements at their laboratory, and Table XIX not only supported this difference but indicated the program elements where the difference occurred; similarly for their comparisons in the functional areas. Comparisons of the two San Diego panels substantiated the earlier claim that Program Element Two, Education and Training, contributed significantly to their overall fit with the model.

Using the percentage amount of contribution per program element as a measure, the results from all nine panels were unanimous for three elements; Drug Abuse (1) provided a positive contribution, Manpower/Personnel Cost Systems (4) and Personnel Management Systems (6) provided negative contributions. The results for three other elements indicated they provided negative contributions: Occupational R&D (3), Manpower Requirements (5) and Attitude/Motivation (12) The remaining 12 elements provided positive contributions to some panel's regressions and negative to others.

V. CONCLUSION

The Ford procedure provided an acceptable, economic and efficient method of quantifying the survey responses. One hundred percent response to the survey would be necessary to ensure the weights assigned by a panel completely reflected that panel's rankings. However, since the sensitivity to an individual response decreases as the proportion increases, six of the nine panels' responses were deemed representative for this analysis.

The selected model provided results sufficient to compare the difference between the data from the panels as pertains to the overall Navy Personnel Research Program in support of GOR 43, the program elements at the two laboratories, and the functional areas encompassing more than two program elements. The results from application of the model to these separate tasks substantiated and supplemented the individual results from a single task. The consolidated results manifest these differences. Extension of the model for parameter estimation, prediction or evaluation of single program elements must remain tentative until a more extensive data base can be collected.

This model and analysis treated recommended changes to the Navy Personnel Research Program exogenously. To do otherwise would have required value judgments as to which panels' rankings were better and by how much, as well as validation of the selected model as deterministic. These were both beyond the scope of the present work, but the results herein should be of assistance in recommending changes.

APPENDIX A

SAMPLE QUESTIONNAIRE

MILITARY SIGNIFICANCE AND INVESTMENT RISK OF PERSONNEL AND TRAINING RESEARCH PROGRAMS

1. GENERAL

Here are 18 descriptions of program elements in the Navy's Personnel Research Program. Please rank them twice according to two different criteria. The first time, rank them according to their military significance. The second time, rank them according to the investment risk in committing Navy resources to them.

a. Criterion 1

Military significance refers to the needs of the Navy. Rank from most to least the importance of problems that lie in the area of each program element. Indicate where the Navy would obtain the greatest payoff given that the research is successful.

b. Criterion 2

Investment risk refers to the probability of a successful research effort independent of the value of the payoff (Criterion 1). Rank these elements from good to bad for the probability that the research will be successful. A research effort is successful if solutions to problems--or significant improvements--can be developed within a period of approximately ten years.

2. RULES

a. You need not rank all elements for each criterion--only those you have confidence in ranking. You need not rank the same number of elements for each criterion.

b. Use as few (3) or as many (18) ranks as you desire.

c. Ties (up to six) are permitted within any rank you set up.

d. A rank of one is the greatest in military significance and the best in investment risk.

3. SUGGESTED APPROACH

Do the rankings separately for each criterion. The following appraoch is suggested:

a. Separate the element descriptions into those you will and will not rank.

b. Separate those you rank into broad hierarchical categories for a start.

c. Try to break down the categories into finer discriminations; continue until you cannot break down any of the categories further.

d. Consecutively assign numbers to the categories from one to as many categories (ranks) as you have.

01 DRUG ABUSE

This area consists of research and development for (a) determining causes, attitudes toward, and extent of drug abuse in the Navy; (b) exploration of means to reduce, prevent, and control drug abuse; and (c) means to provide effective education, counseling, and rehabilitation programs for Naval personnel and dependents.

Typical Projects

1) Early Identification of Drug Abusers and Potential Drug Abusers

2) Methodology for Reducing Drug Abuse

02 EDUCATION AND TRAINING

The two mutually supporting purposes of Education and Training research and development are (1) improving Navy training and (2) development of principles and technology of training. Navy requirements call for more accurate definition of training methods directed toward meeting future job requirements. Research and development in this area involves work on the broad spectrum of problems related to deriving and specifying appropriate training content and developing and evaluating ways to improve acquisition of training objectives. Research in this area also includes specific problems in learning, perception, job aids, programming, displays, simulation and management as they relate to improvement of training.

Typical Projects

1) Computer Administered Instruction

2) Computer Managed Instruction

03 OCCUPATIONAL RESEARCH AND DEVELOPMENT

Development, test, and evaluation of new and improved techniques for describing, evaluating, structuring, and re-engineering Navy occupations for optimal matching of available manpower characteristics to changing job requirements. Involves new methods for determining skills required for effective performance of occupations and the storage and retrieval of occupational data pertaining to work requirements of Navy Personnel.

Typical Projects

1) Design of Navy Occupational Analysis System and Occupational Data Bank for Officer and Enlisted

2) Development of Optimum Enlisted Classification Structure

04 MANPOWER/PERSONNEL COST SYSTEMS

Development, test, and evaluation of new and improved (a) techniques for the acquisition, computation, storage, and retrieval of manpower/personnel cost data; (b) techniques for determining the costs of various mixes of men and equipment, personnel management policies, and personnel utilization factors; and (c) measures which permit manpower requirements planners to trade off cost and effectiveness in order to evaluate available options. The principal objective is to furnish total government costs from procurement through post-separation which can be used to formulate cost-related decisions concerning the total Navy manpower personnel system.

Typical Projects

1) Development of Cost Techniques for Use in Determining Manning Levels

2) Budget Cost Management for Personnel Planning

05 MANPOWER REQUIREMENTS

Development, test, and evaluation of techniques for defining and displaying quantitative and qualitative manpower requirements for all functions performed ashore and afloat including upward aggregation of requirements to the total naval establishment. The techniques must be responsive to changing operational requirements, system design innovations, and available human resources. Includes the development of manpower/productivity models and the use of simulation techniques to test alternative manning and manpower management concepts in terms of cost and total system effectiveness. The principal objective is to develop methods for determining manpower requirements which are capable of responding quickly to changes in resources and military objectives and requirements.

Typical Projects

1) Manpower Planning and Allocation Techniques (Ashore)

2) Reduction of Manpower Requirements Afloat

06 PERSONNEL MANAGEMENT SYSTEMS

Development, test, and evaluation of tools to improve the quality of personnel management by increasing the accuracy of force projections, by responding more rapidly to changing policies and operational conditions, and by projecting the effects of current and proposed personnel policies to determine the most effective personnel management strategies. These tools are usually in the form of computerized models of the personnel system which can be used to reflect the relationship between such variables as recruit input, advancement, and attrition and to project the effects of these variables upon the size and skill composition of the personnel force.

Typical Projects

1) Development of Advanced Management Techniques for Improving Enlisted Personnel Planning (Advancement, Strength, and Training Planning Model)

2) New Techniques to Forecast Career Input Requirements

07 MAN-MACHINE SYSTEMS R&D

This area is primarily concerned with the implementation of human operator considerations in the development, operations, and maintenance of new and current organizational, weapons and support systems. Goals include (a) an understanding of, and techniques to quantify and extrapolate, meaningful relationships among human performance, equipment characteristics, and environmental conditions; (b) development and application of man-machine standards, specifications, and tradeoff analysis methodologies in systems development, planning, and procurement; and (c) techniques for application of human capabilities to anticipated demand of future weapon systems.

Typical Projects

1) Advanced Methods for Enhancing Human Performance in Critical Operations

2) Simulation Technology for New System Personnel and Training Requirements Determination and Man/Machine Tradeoffs

08 SELECTION/CLASSIFICATION

The program area involves development, test, and evaluation of new and improved methods for (a) more accurate and effective selection and classification of individuals; (b) determining their training requirements; and (c) matching the man to the job. Selection usually refers to the process of determining which individual or individuals should be accepted or rejected with regard to a specific program. Classification refers to the process of determining and categorizing the appropriate skill qualifications of an individual in such a way that each school or job quota is filled with particular individuals most likely to perform successfully.

Typical Projects

1) Enhancement of Personnel Effectiveness in Overseas Environments (Homeporting)

2) Enlisted Classification Test Development

09 APPLIED SYSTEMS DEVELOPMENT

Identification of personnel and training requirements, establishment of initial operator performance standards and maintenance skill requirements, assistance in man-machine tradeoff studies, and conduct of studies to enhance man-machine compatibility for candidate and prototype systems under development. The effort frequently involves development of training objectives, review of course and lesson plans, and the evaluation of operator and maintenance personnel training.

Typical Projects

1) ASW Ship Towed Torpedo Countermeasures System (NIXIE)

2) Integrated Shipboard Communications System (ISC)

10 CAREER STRUCTURES

Development, test, and evaluation of new and improved techniques for (a) arriving at optimal career progression patterns; (b) methods for utilizing occupational, manpower/personnel cost, and other manpower factors data in determining optimal combination of grade and skill profiles required to satisfy Navy operational requirements; and (c) techniques for providing balance between needs of the service based on technological projections, and needs of the individual related to opportunities for increased responsibility, advancement, prestige, and compensation. Typical outputs are optimum length of careers, optimum level of specialization, and optimum amount of fleet experience required of each grade of occupational specialty to meet changing military requirements.

Typical Projects

1) New Electronics Career Concepts

2) Development and Test of New/Revised Components of Officer Personnel System

11 PERSONNEL RETENTION

This is a multi-faceted program exploring and developing methods and techniques for inducing qualified and needed personnel to remain on active duty, and programs which meet fluctuating needs of the naval service. Included are (a) investigations in psychometric technology to predict retention for use in selection and assignment; (b) development of more fair and effective evaluation of performance through computer-aided analysis and display of performance evaluation; and (c) development of improved techniques for selection and training of personnel in ratings which administer personal services to other naval personnel.

Typical Projects

1) Development of Psychometric Instruments for Identifying Career Motivated Applicants

2) Factors Affecting Retention (Personnel Reactions to Incentives, Naval Conditions, and Experiences)

12 ATTITUDE/MOTIVATION

Develop sociometric and psychometric instruments and conduct controlled experiments for purposes of studying man's values, needs, aspirations, prejudices and expectations to achieve a better understanding on how they affect his thinking, feelings and reactions to people, groups, social issues or events in his environment. The objective in achieving such an understanding is better prediction and control of an individual's behavior, motivation, and performance.

Typical Projects

1) Development of Attitudinal Assessment Techniques

2) Assessment of Attitudes and Motivations of Marginal Personnel

13 MINORITY DISCRIMINATION MEASUREMENT AND REDUCTION

This area is comprised of R&D support for BuPers and Navy objectives to intensify and expand efforts to eliminate racial, sex, and cultural discrimination and bias in the Navy.

Typical Projects

1) Development and Evaluation of Culturally Unbiased Instruments and Procedures for Selection of Officers and Enlisted Personnel

2) Analysis of Minority Discrimination in Procurement, Discipline, and Advancement

14 ORGANIZATIONAL EFFECTIVENESS

Development and evaluation of techniques for measuring overall military effectiveness of organizational units under various contingencies. This involves the development of empirically based criteria and the relative importance of criteria which should be applied in making judgments of organizational effectiveness. It includes studies of individual and organizational behavior and evaluative research into managerial practices and organizational characteristics. The principal objective is the enhancement of organizational effectiveness in relation to organizational goals and total system effectiveness.

Typical Project

1) Development of Concepts and Criteria for Organizational Effectiveness

15 DISTRIBUTION/ASSIGNMENT

This area encompasses research and development in the managerial functions of personnel distribution, assignment, and rotation as carried out by the Bureau of Naval Personnel. The program is concerned with the development and evaluation of new and improved techniques and procedures based on modern computer technology for (1) the equitable, quantitative and qualitative allocation ("distribution") of the personnel and inventory among the ships, aircraft squadrons, and shore stations of the Navy; (2) the optimal match ("assignment") of specific individuals to particular billets in terms of prescribed criteria; and (3) the planned, periodic reassignment ("rotation") of career personnel to the various categories of sea, shore, and overseas duty. Objectives are the optimum matching of personnel and billets, improved manpower utilization systems, and the optimum matching of manpower requirements and resources over time.

Typical Projects

1) Centralized Enlisted Personnel Distribution and Management

2) New Concepts for Centralized Enlisted Rating Control

16 R&D RESOURCES MANAGEMENT

This area includes three subareas dealing with efficient use of R&D resources. One deals with the selection and evaluation of scientific/research personnel employed by the laboratories. Research in this area is aimed at the development of performance evaluation criteria in the areas of quantitative and qualitative work output and scientific/technical contributions. Another subarea concerns the identification of significant problem areas, assignment of priorities, and selection of tasks to be performed to assure maximum return for the "R&D dollar". A third subarea is the continuing study of the implementation of research recommendations by consumers as a basis for future research planning and to facilitate the implementation of significant R&D products.

Typical Project

1) Methodology for Developing and Evaluating GOR-43

17 RECRUITMENT/PROCUREMENT

Development, test, and evaluation of methods and techniques for (1) attracting and obtaining required skill composition, racial mix, and educational levels and for (2) improving selection policies and programs relating to manpower requirements, implications of an all-volunteer force, manpower ceilings reductions, and changes in strategic guidance. The principal objective is to obtain personnel with the appropriate innate and acquired characteristics to meet all of the performance requirements and changing requirements of future naval forces.

Typical Projects

1) Recruiter Selection Techniques

2) Evaluation of Enlisted to Officer Transition Programs

18 PERSONNEL PERFORMANCE

Development of on-the-job performance standards and criteria and improved proficiency measurement techniques to assure that selection, assignment, and promotion factors are job-relevant. The goal is maximum readiness of individuals and units.

Typical Projects

1) Criterion Development for Selection and Performance Assessment

2) Improving Enlisted Performance Evaluation and Advancement Systems

APPENDIX B

COMPLETE REGRESSION RESULTS

	ALL	100	200	300	400	500	600	700	800	900
C	.33727	.33727	.33727	.33727	.33727	.33727	.33727	.33727	.33727	.33727
B_o	-.04574	-.12725	.16349	.13592	-.17358	.02724	-.03727	-.53277	-.02996	-0.36328
b_1	.37465	.15352	.13586	.09314	.34008	.39754	.43541	0.0	.57617	.83470
SE_1	.07074	.14056	.37330	.32819	.09770	.44365	.12663	0.0	.32219	.18191
M	.54198	.56744	.52134	.54078	.57856	.50818	.58401	.52230	.52214	.53314
SD_M	.42556	.50055	.29319	.37185	.60747	.26592	.67522	.32198	.32903	.35537
b_2	.33431	.67772	.19239	.27068	.58626	.21049	.21478	1.71944	.11667	.50028
SE_2	.08393	.15686	.31099	.26247	.16096	.47811	.17443	.51635	.26046	.31774
I	.53829	.55689	.53517	.55781	.53577	.51317	.55991	.50601	.56910	.51080
SD_I	.35869	.44582	.35193	.46496	.36873	.24676	.49017	.15780	.40701	.21150
R^2	.3362	.6202	.0403	.1210	.8896	.1065	.8369	.4094	.1774	.6591
F	40.235	12.267	0.315	1.032	60.422	0.894	38.486	11.089	1.617	14.499

REGRESSION RESULTS FOR PANEL PAIRS

	100 & 200	300 & 500	400 & 600	300 & 600	400 & 500
C	.33728	.33728	.33728	.33728	.33728
b_o	-.01933	.10160	-.08582	.00606	.09690
b_1	.16575	.20351	.39551	.34361	.40227
SE_1	.15781	.2530	.08001	.14519	.15982
M	.54439	.52448	.58129	.56240	.54337
SD_M	.40496	.31903	.6330	.53767	.46353
b_2	.48784	.24078	.35264	.24689	.41108
SE_2	.16078	.2196	.11842	.16579	.23942
I	.54603	.53549	.54784	.55886	.52447
SD_I	.39748	.36755	.42766	.47086	.30943
R^2	.2792	.1032	.8460	.4505	.4841
F	6.392	1.899	90.633	13.527	15.483

REGRESSION RESULTS EXCLUDING PANEL PAIRS

	100 & 200	300 & 500	300 & 600	400 & 500	400 & 600
C	.33727	.33727	.33727	.33727	.33727
b_0	-.04055	-.07925	-.08897	-.03056	0.02091
b_1	.45316	.39192	.40669	.35686	.35093
SE_1	.08024	.07082	.08350	.08212	.09943
M	.54130	.54699	.53615	.54159	.53076
SD_M	.43283	.45238	.39009	.41606	.34713
b_2	.24721	.37499	.39104	.32194	.32103
SE_2	.09965	.08959	.10125	.09169	.10203
I	.53608	.53909	.53241	.54224	.53556
SD_I	.34850	.35761	.32168	.37260	.33834
R^2	.3708	.4149	.3123	.2963	.1923
F	36.362	43.604	27.931	25.890	14.642

REGRESSION RESULTS EXCLUDING ONE PANEL

	ALL	100	200	300	400	500	600	700	800	900
C	.33727	.33727	.33727	.33727	.33727	.33727	.33727	.33727	.33727	.33727
b_o	-.04574	-.02820	-.05979	-.07061	-.02526	-.05167	-.05025	-.04112	-.05834	-.02876
b_1	.37465	.43448	.38296	.39216	.35815	.37391	.37697	.39642	.31845	.33248
SE_1	.07074	.07893	.07123	.07145	.08133	.07067	.08173	.07216	.07564	.07495
M	.54198	.53880	.54456	.54213	.53714	.54621	.53673	.54445	.54446	.54309
SD_M	.42556	.41716	.44002	.43297	.39980	.44196	.38659	.43763	.43701	.43460
b_2	.33431	.24519	.34996	.36443	.31574	.34115	.34577	.29976	.41582	.34236
SE_2	.08393	.09470	.08689	.08965	.09064	.08423	.09268	.08388	.09348	.08723
I	.53829	.53596	.53868	.53585	.53860	.54143	.53557	.54232	.53444	.54172
SD_I	.35869	.34769	.36073	.34511	.35873	.37084	.34092	.37649	.35359	.37340
R^2	.3362	.3237	.3796	.3749	.2719	.3657	.2747	.3575	.3711	.3194
F	40.235	33,747	43.128	42.279	26.322	40.643	26.696	39,222	41.596	33.083

REGRESSION RESULTS FROM PROGRAM ELEMENTS UNDER COGNIZANCE OF NAVPERSLAB, WASH, D.C.

	ALL	100	200	300	400	500	600	700	800	900
C	.24545	.24545	.24545	.24545	.24545	.24545	.24545	.24545	.24545	.24545
b_o	.13989	.11054	.13468	.12430	.01392	.20143	.01898	-.37109	.16359	-.00842
b_1	.11573	.06827	.09090	.08314	.18422	-.04001	.53131	.64318	.13975	.35193
SE_1	.04769	.08549	.16493	.11676	.24079	.34449	.48359	.26149	.22148	.21842
M	.44719	.48584	.47948	.62303	.37441	.45426	.33311	.42951	.44487	.40025
SD_M	.29709	.53048	.31048	.43798	.19829	.17811	.10433	.14404	.28649	.22549
b_2	.10419	.21119	.11310	.11257	.36079	.11385	.12154	.77247	.03161	.23142
SE_2	.04237	.13153	.11257	.09118	.27396	.21857	.21765	.47800	.14800	.23277
I	.51642	.48174	.59405	.61607	.45058	.54269	.40721	.44054	.62301	.48835
SD_I	.33435	.34480	.45489	.56085	.17428	.28072	.23181	.07880	.42875	.21159
R^2	.1308	.3030	.1840	.3238	.2209	.0361	.2041	.5154	.0505	.2617
F	7.224	1.739	0.904	1.915	1.137	0.150	1.026	4.254	0.0213	1.418

REGRESSION RESULTS FROM PROGRAM ELEMENTS UNDER COGNIZANCE OF NAVPERSLAB, SDGO

	ALL	100	200	300	400	500	600	700	800	900
C	.48157	.48157	.48157	.48157	.48157	.48157	.48157	.48157	.48157	.48157
b_o	-.09714	-.27966	.11188	-.56105	.26548	-.55803	-.19716	-.78770	-.02807	-.28109
b_1	.30538	.22270	.21049	.92778	.36703	-.86649	.44336	-.08575	.79189	1.23854
SE_1	.15373	.37388	1.61505	1.43354	.14546	1.14979	.17756	.54827	.69441	.67190
M	.69180	.69567	.57741	.41153	.89938	.59291	.97936	.66811	.64357	.75834
SD_M	.54658	.45771	.22016	.20042	.88518	.36577	1.00547	.46751	.37654	.47611
b_2	.64154	.89825	.54981	1.41725	.62265	3.36860	.30856	2.17865	0.0	.32352
SE_2	.21304	.29125	1.96406	1.06867	.23492	2.21628	.26815	1.28172	0.0	1.39837
I	.57276	.67498	.45135	.46626	.66964	.46113	.79247	.60889	.48438	.54576
SD_I	.39442	.58755	.18104	.26685	.54809	.18976	.66581	.19998	.38638	.22877
R^2	.4827	.7864	.0371	.6626	.9614	.4239	.9348	.4250	.2064	.6578
F	19.907	7.363	0.0770	3.948	50.404	1.471	28.661	1.478	1.300	3.845

REGRESSION RESULTS FROM PROGRAM ELEMENTS IN THE MANPOWER RESOURCES MANAGEMENT FUNCTIONAL AREA

	ALL	100	200	300	400	500	600	700	800	900
C	.31275	.31275	.31275	.31275	.31275	.31275	.31275	.31275	.31275	.31275
b_o	.42416	.48353	1.18854	.20878	.62265	.50955	1.04556	.87061	-.90932	.22139
b_1	.09907	-.03869	1.09521	.05735	.36471	.30710	-.51463	.29714	1.79645	.60454
SE_1	.05270	.31092	.92989	.18145	1.67996	.16922	.42140	.31071	.07458	.09616
M	.46388	.52466	.64207	.82232	.26151	.47907	.34906	.47615	.36106	.25903
SD_M	.30915	.34338	.30948	.60796	.05130	.26387	.08868	.17635	.17338	.17071
b_2	-.25647	-.21906	-2.75828	.06663	-.71887	-.52980	-1.02596	-1.38282	.88126	-.13007
SE_2	.08481	.49047	2.00724	.48700	.84476	.17480	.32151	1.17878	.04781	.13518
I	.61358	.68695	.57246	.85272	.56377	.64917	.53918	.50573	.65071	.50152
SD_I	.19212	.21768	.14337	.22652	.10202	.25545	.11623	.04648	.27046	.12143
R^2	.2345	.2085	.7114	.1228	.4804	.9019	.9106	.9244	.9987	.9903
F	5.054	0.132	1.233	0.070	0.462	4.594	5.091	6.112	380.44	50.891

REGRESSION RESULTS FROM PROGRAM ELEMENTS IN THE PERSONNEL OPERATIONS R&D FUNCTIONAL AREA

	ALL	100	200	300	400	500	600	700	800	900
C	.25271	.25271	.25271	.25271	.25271	.25271	.25271	.25271	.25271	.25271
b_o	1.4040	.11593	.07767	.06265	.04922	.07762	.16235	.16759	.44051	.20582
b_1	.07272	.07975	.09016	.29679	.12851	0.0	.10583	.02796	.07809	-.05476
SE_1	.02696	.05016	.12353	.12611	.10445	0.0	.12822	.10050	.1101	.17338
M	.60748	.79468	.63262	.42148	.62787	.56276	.61207	.64428	.58490	.58672
SD_M	.36524	.63066	.27163	.21867	.32641	.35646	.34426	.46762	.34176	.28990
b_2	.13732	.15240	.22485	.17204	.2467	.40304	.04802	.12356	.12299	.14843
SE_2	.03925	.09897	.12156	.15045	.16881	.18229	.13973	.27995	.09166	.24037
SD_I	.25087	.31960	.27604	.18330	.20196	.16530	.31592	-16786	.41051	.20910
R^2	.2964	.5544	.7219	.6764	.4824	.4944	.2104	.0827	.3695	.0876
F	12.640	2.488	5.193	4.180	1.864	4.889	0.533	0.180	1.172	0.192

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13. ABSTRACT

A recent survey of the Navy Personnel Research Community is subjected to a comparative analysis of the various program elements in the research program in support of General Operational Requirement 43, Personnel Logistics, for military significance and investment risk. The qualitative appraisal of the individuals polled are quantified, using the Ford procedure, and the resultant data analyzed, using a multiple regression model, to determine how much agreement/disagreement there is in the community, where any difference might be, and from which program elements the differences stem. The results should provide assistance for the decision-maker in determining the right project areas for the Navy Personnel Research Program to be maximally effective.

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